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Viral Hepatitis in the U.S. Air Force, 1980-1989; An Epidemiological and Serological Study

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This paper reports the epidemiology of hospital-diagnosed acute viral hepatitis in US Air Force personnel from 1980-1989. First hospitalizations for viral hepatitis generally declined, ranging from 24.6 to 47.2 per 100,000 personnel. Hepatitis rates were higher among men, (RR = 1.3; 95% C.I., 1.1 - 1.5) and higher among blacks, compared to whites (RR = 1.4; 95% C.I., 1.3 - 1.6). Analysis of risk associated with various occupations demonstrated an increased risk of viral hepatitis for procedurally oriented medical personnel (physicians, clinical nurses, dentists) when compared to all other occupations (RR = 1.5; 95% C.I., 1.1-1.9). Pilots and navigators demonstrated a decreased risk of acute viral hepatitis. Members hospitalized for hepatitis B had a prior or concurrent diagnosis for sexually transmitted disease in 37% of cases; for drug abuse, 32% of cases. Serum samples from 332 individuals demonstrated that hepatitis A had the highest rate of agreement (84%) between serology and hospital discharge diagnosis. Only 3% of individuals with the diagnosis of NANB hepatitis were positive for hepatitis C.

immunization, sexually transmitted disease, drug abuse, hepatitis

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Viral Hepatitis in the U.S. Air Force, 1980–89: An Epidemiological and Serological Study

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This paper reports the epidemiology of hospital-diagnosed acute viral hepatitis in U.S. Air Force personnel from 1980–89. First hospitalizations for viral hepatitis generally declined, ranging from 24.6 to 47.2 per 100,000 personnel. Hepatitis rates were higher among men, (RR = 1.3; 95% C.I., 1.1–1.5) and higher among blacks, compared to whites (RR = 1.4; 95% C.I., 1.3–1.6). Analysis of risk associated with various occupations demonstrated an increased risk of viral hepatitis for procedurally oriented medical personnel (physicians, clinical nurses, dentists) when compared to all other occupations (RR = 1.5; 95% C.I., 1.1–1.9). Pilots and navigators demonstrated a decreased risk of acute viral hepatitis. Members hospitalized for hepatitis B had a prior or concurrent diagnosis for sexually transmitted disease in 37% of cases; for drug abuse, 32% of cases. Serum samples from 332 individuals demonstrated that hepatitis A had the highest rate of agreement (84%) between serology and hospital discharge diagnosis. Only 3% of individuals with the diagnosis of NANB hepatitis were positive for hepatitis C.

VIRAL HEPATITIS continues to be an important cause of morbidity in the U.S. Armed Forces. Operational responsibilities in developing countries where viral hepatitis is endemic increase the threat of disease acquisition among U.S. military personnel. Numerous studies addressing demographic and other risk factors for viral hepatitis have been conducted in the U.S. Army (4,5,8,11,17,24) and Navy (1,9,12,13,15,16,19). The last comprehensive analysis of viral hepatitis in the U.S. Air Force (USAF) was conducted nearly 20 years ago (7), although several recent studies have included subpopulations of USAF personnel (14,23).

The objectives of this study were to review the epidemiology of viral hepatitis in USAF personnel during the period 1980–89; assess the relative proportion of non-A, non-B (NANB) hepatitis which may have been due to the newly identified hepatitis C virus (2,3,10); and based upon these findings and other relevant analyses, review current immunization and screening practices. During the course of this study we were able to assay a limited number of serum specimens for the newly described hepatitis E viral (4).

MATERIALS AND METHODS

We reviewed hospital discharge records for all active duty USAF personnel admitted to any USAF medical treatment facility (MTF) and relevant personnel data on all active duty USAF personnel during the period January 1, 1980, to December 31, 1989. Records are collected and maintained in computerized databases by the U.S. Air Force Medical Support Agency and U.S. Air Force Military Personnel Center.

Specific diagnostic categories [International Classification of Diseases, Adapted, 9th Revision (ICDA-9)] of viral hepatitis were analyzed: hepatitis A (070.0 and 070.1); hepatitis B (070.2 and 070.3); and NANB hepatitis (070.4, 070.5, 070.6, and 070.9). Only the first hospital admission for a specific viral hepatitis was used for analysis when a patient was admitted more than once during the study. Variables analyzed in this study included specific hepatitis diagnosis; year hospitalized; age; sex; race (self-described, Hispanic classified as white); occupation (medical, dentist/clinical, nurse/doctor, pilot/navigator and other); and overseas duty (outside the continental United States). Age-specific an-

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nual incidence rates were calculated for the study population (5,792,554 person-years). The relative risk (RR) for hepatitis associated with age, sex, race, or occupation was determined on the basis of age-specific rates. Person-years of risk could not be calculated for history of overseas duty, sexually transmitted diseases (STD's), and drug abuse.

Histories of prior or concurrent hospitalization with either drug abuse (use of a psychoactive drug in a nonprescribed or socially disapproved of manner) or STD was also included as a risk factor. Data on outpatient diagnoses of hepatitis, drug abuse, or STD were not available for analysis; therefore, a proportional comparison was made for each type of hepatitis.

A total of 1,907 individuals were identified as having specific discharge diagnoses of hepatitis A, B, or NANB. A number of individuals had multiple specific diagnostic codes for a total of 1,942 diagnoses. Of the 1,907 individuals, 767 (40%) were still on active duty in 1991, and serum specimens were requested from them through their local MTF.

A 15-ml blood sample was obtained from 332 individuals (42%) of those still on active duty and tested by the Epidemiologic Research Division at Brooks AFB, TX. Serum samples were tested by enzyme immunoassay (EIA) for antibodies to hepatitis A virus (total anti-HAV), hepatitis B core antigen (total anti-HBc), hepatitis B surface antigen (anti-HBs), and hepatitis C (total anti-HCV). Samples positive by EIA for anti-HCV were verified with a first generation HCV neutralization EIA assay (Abbott Laboratories, North Chicago, IL). Samples that were negative for markers to hepatitis A, B, and/or C were tested by the U.S. Naval Medical Research Institute, Rockville, MD, for hepatitis E.

Hospitalization rates and 95% confidence intervals (C.I.) were calculated using standard methods for the binomial distribution. Proportions were compared using the chi-square statistic.

RESULTS

Active duty USAF personnel strength during 1980–89 ranged from approximately 558,000 to 608,000 (mean = 579,000) per year. A mean of 72,400 active duty USAF personnel were hospitalized annually, with an average of 194 (0.03%) of these admissions coded as hepatitis A, B, or NANB hepatitis. The mean annual incidence of hospitalizations for viral hepatitis during this 10-year period was 33.5 per 100,000 person-years. From 1980–89, total first hospitalizations for viral hepatitis ranged between 24.6 to 47.2 per 100,000 personnel (Table I). In general, the rate of overall hepatitis admissions declined during this period. Although a significant decrease in the incidence of hepatitis A and NANB hepatitis was found, there was an increase in hepatitis B admissions in 1987 and 1988 (Fig. 1).

Overall, hepatitis rates were higher among men, compared to women (RR = 1.3; 95% C.I., 1.1–1.5) and higher among blacks, compared to whites (RR = 1.4; 95% C.I., 1.3–1.6) (Table II). The highest hepatitis admission rate (39.7 per 100,000 personnel) was found in the 20–24 year age group (Fig. 2). Hepatitis B accounted for 41% of all hepatitis hospitalizations during the 10-year period. Hepatitis B rates were higher in members under the age of 30, compared to members 30 years of age or older (RR = 4.8; 95% C.I., 3.6–6.3). Increased rates of hepatitis B were seen among men (RR = 1.8; 95% C.I., 1.4–2.4) and among blacks (RR = 2.4; 95% C.I., 2.0–2.9). Hepatitis A rates were higher among whites compared to blacks (RR = 1.5; 95% C.I., 1.2–2.0). Non-A, non-B hepatitis rates did not demonstrate significantly different gender or racial differences.

Analysis of risk associated with various occupations demonstrated an increased risk of acute viral hepatitis for procedure-oriented medical personnel (physicians, clinical nurses, dentists), 47.6 vs. 32.8 per 100,000 (RR = 1.5; 95% C.I., 1.1–1.9), compared to all other occupations. Paradoxically, among a broader group designated "medical" (adding medical technologists, clerical staff), risk was decreased (17.4 vs. 34.8 per 100,000; RR = 0.5; 95% C.I., 0.4–0.6). Pilots and navigators also demonstrated a decreased risk of acute viral hepatitis (Table III).

Active duty members hospitalized for hepatitis B were more likely to have a history of prior or concurrent

TABLE I. INCIDENCE OF VIRAL HEPATITIS, BY YEAR AND HEPATITIS TYPE: USAF ACTIVE DUTY, 1980–89.

	HEP A		HEP B		HEP NANB		Total HEP	
Year	#	rate*	#	rate	#	rate	#	rate
1980 (n = 557,969)†	89	16	65	11.6	104	18.6	258	46.2
1981 (n = 570,302)	59	10.3	66	11.6	91	16.0	216	37.9
1982 (n = 582,845)	82	14.0	68	11.7	66	11.3	216	37.1
1983 (n = 592,044)	60	10.1	60	10.1	59	10	179	30.2
1984 (n = 597,125)	38	6.4	64	10.7	45	7.5	147	24.6
1985 (n = 601,515)	35	5.8	71	11.8	53	8.5	159	26.4
1986 (n = 608,199)	51	8.4	42	6.9	64	10.5	157	25.8
1987 (n = 607,035)	53	8.7	87	14.3	46	7.6	186	30.6
1988 (n = 576,446)	52	9	179	31.1	41	7.1	272	47.2
1989 (n = 570,880)	21	3.7	94	16.5	37	6.5	152	26.6
Total (n = 5,792,554)	540	9.3	796	13.7	606	10.5	1942	33.5

* per 100,000 person-years.
† n = person-years.
# = cases.

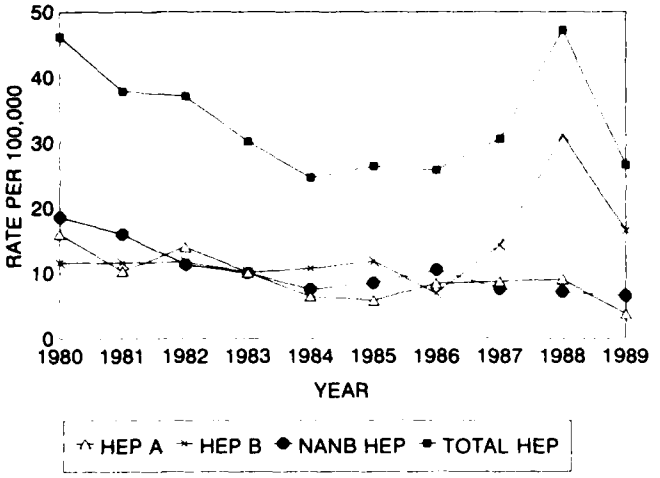

Fig. 1. Incidence of viral hepatitis, by year and hepatitis type USAF active duty, 1980–89.

diagnosis for STD's (37%) or drug abuse (32%) compared to those hospitalized for hepatitis A and NANB hepatitis. A history of overseas duty was more likely to be associated with a diagnosis of hepatitis A (51%) or NANB (48%) (Table IV).

There were 332 individuals, discharged from MTF's between 1980–89 with a specific hepatitis diagnosis code, who submitted serum samples for this study. Laboratory testing revealed 321 positive serologies among 272 individuals (some with evidence of multiple hepatitides), and 60 individuals were negative for all assays (Table V). Hepatitis A had the highest rate of agreement (84%) between serology and hospital discharge diagnosis. Individuals with a hospital diagnosis of hepatitis B had serological evidence in 77% (68/88) of those tested. Of individuals with a diagnosis of NANB hepatitis, 50% (62/125) had serological evidence of hepatitis A, and 26% (32/125) had evidence for hepatitis B. Only 3% (4/125) of individuals with the diagnosis of NANB hepatitis were positive for hepatitis C. Those individuals with negative hepatitis A, B and C serologies were tested for hepatitis E, and only one tested positive.

DISCUSSION

This study demonstrates that acute viral hepatitis remains a significant, probably declining, cause of morbidity among active duty USAF members. Incidence rates for hepatitis declined steadily from 1980 (46.2 per 100,000) until 1986 (25.8 per 100,000). The dramatic increase in hepatitis B incidence rates in 1987–88 was most likely due to detection bias resulting from the total-force human immunodeficiency virus (HIV) screening program initiated in 1986. All active duty members found positive for HIV antibody were referred for complete medical evaluations, including hepatitis serologies. A 59% prevalence of anti-HBc was found by Lucey et al. in a cohort of 493 HIV-infected USAF patients (18). Meier et al. studied a larger (cumulative) cohort of the same population, approximately 4 years later, and detected an anti-HBc seroprevalence of 54% (20). The relatively rapid return to the "baseline" (overall hepatitis rate of 26.6 per 100,000) in 1989 suggests that total-force HIV screening had identified all individuals who were serologically positive for hepatitis, pursuant to their comprehensive medical evaluation.

The elevated risks for hepatitis B and total hepatitis for active duty males, members less than 30 years old, and blacks are consistent with previous studies among military personnel (8,9,15). The higher proportion of individuals with prior or concurrent hospital discharge diagnoses for STD's and drug abuse is also consistent with U.S. Army and Navy studies. In our study, "drug abuse" included nonintravenous substance use and, therefore, most likely serves as a marker for risk-taking behavior rather than a primary route of disease acquisition.

We did not find an increase in viral hepatitis among pilots and navigators, individuals who by merit of frequent travel to international destinations might be considered at greater risk of disease exposure. A previous analysis of tuberculosis among USAF members (21) did not demonstrate an increased risk of disease based on the presence or absence of flying status. We were unable to obtain accurate measurements of risk associated with assignment to specific overseas locations or risk-taking behavior due to limitations in the existing data. It is important to note that a recent study of hepatitis B acquisition among a military population, which included USAF personnel in the Philippines, demonstrated an elevated risk of disease among personnel with a history of STD or prostitute contact (14).

Physicians, dentists, and clinical nurses, in contrast, were shown to have an elevated risk of acquiring hepatitis consistent with previously described occupational risk. The importance of stratifying medical occupations by the degree of exposure to potentially infectious body fluids is demonstrated. We found that "medical" occupations, when loosely defined, did not demonstrate an elevated risk for total hepatitis.

This analysis demonstrated strong agreement between a hospital discharge diagnosis of hepatitis A or B and serological results for those individuals who remained on active duty in 1991–92. The highest degree of agreement was observed among active duty members who had been hospitalized for hepatitis A.

Hepatitis C does not appear to be a significant cause of hepatitis among USAF members, based upon the serological results from the 125 individuals who were hospitalized with a diagnosis of NANB hepatitis and agreed to donate blood for this study. There is no reason to believe that these individuals represent a biased sample relative to the entire population of NANB hospitalized individuals (n = 606) over the 10-year period. One thing we would like to know, for future reference, would be the prevalence of viral hepatitis serological markers of recruits as they enter active duty.

While the objective of this analysis was not to determine the incidence of hepatitis E, we were able to test for this agent in individuals who were found to be negative for hepatitis A, B, and/or C. Only one positive hepatitis E sample was detected, supporting the view that hepatitis E has not been a problem for the U.S. Air Force, at least among those individuals hospitalized between 1980–89 for hepatitis.

TABLE II. INCIDENCE OF VIRAL HEPATITIS PER 100,000 PERSON-YEARS, BY SEX AND RACE AND HEPATITIS TYPE, USAF ACTIVE DUTY, 1980–89.

	HEP A		HEP B		HEP NANB		Total HEP	
	#	rate	#	rate	#	rate	#	rate
Men (n = 5,075,827)	486	9.6	739	14.6	527	10.4	1752	34.5
Women (n = 716,727)	54	7.5	57	8	79	11	190	26.5
White (n = 4,725,808)	462	9.8	528	11.2	485	16.6	1479	31.2
Black (n = 889,595)	57	6.4	243	27.3	100	11.2	400	45.0
Other (n = 177,151)	21	11.9	25	14.11	21	11.9	67	37.8
Total	540	9.3	796	13.7	606	10.5	1942	33.5

# = cases.
n = person-years.

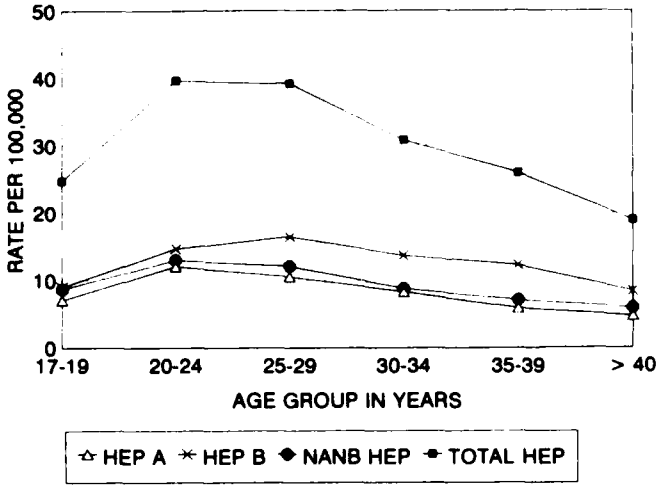

Fig. 2. Incidence of viral hepatitis, by age group and hepatitis type USAF active duty, 1980–89.

TABLE III. INCIDENCE OF VIRAL HEPATITIS PER 100,000 PERSON YEARS, BY PILOT, NAVIGATOR VS. OTHER OCCUPATION, USAF ACTIVE DUTY, 1980–89.

	Pilot/Nav.*		Other†			
Diagnosis	#	rate	#	rate	RR	95% C.I.
Hep A	21	7.2	519	9.4	0.76	(0.5–1.2)
Hep B	18	6.1	778	14.1	0.43	(0.3–0.7)
Hep NANB	19	6.5	587	10.7	0.61	(0.4–1.0)
Total	58	19.8	1884	34.3	0.58	(0.4–0.8)

* Person years at risk = 293,342.
† Person years at risk = 5,499,212.
# = cases.

Current vaccination policies for viral hepatitis include the administration of immune serum globulin for short-term deployments to highly endemic areas. Hepatitis B immunization is administered to all medical personnel potentially exposed to human blood or body fluids. The results of this study support the findings of the CDC and others that individuals demonstrating high risk sexual practices (multiple sexual partners, patients seen in sexually transmitted disease clinics, etc.) (6,22), should be considered candidates for hepatitis B vaccination. Air Force members deploying overseas should also be considered as candidates for hepatitis A vaccines, as they become available in the future.

Major limitations of this study were: the study did not include USAF personnel who may have been hospitalized in non-USAF MTF's; we did not use multi-variate analyses because of relatively small numbers of volunteer sera. The 1980–89 data set was very limited as it related to specific length and location of overseas experiences. Consequently, we were obligated to use very generalized surrogates for risk-taking behaviors. Further analyses suggested by this study include: better assessment of hepatitis risk associated with short and extended place-specific overseas tours; and better delineation of risk-taking behaviors rather than assignment history alone. A prospective study, including non-hospitalized hepatitis patients and analysis-of-variance methodologies, concentrating on hepatitis A and B, would be an important next study. Another study suggested by these data would be a "hospitalization expense" cost-benefit analysis of STD patients who were vs. were not previously vaccinated against hepatitis B. Knowing the prevalence of viral hepatitis markers in

TABLE IV. VIRAL HEPATITIS HOSPITAL DISCHARGE DIAGNOSIS BY OVERSEAS, STD, DRUG USE USAF ACTIVE DUTY, 1980–89.

Diagnosis	Overseas Tour (%)	STD (%)	Drug Use (%)
Hep A (n = 540)	276 (51)	22 (4)	7 (1)
Hep B (n = 796)	328 (41)	295 (37)	255 (32)
Hep NANB (n = 606)	293 (48)	35 (6)	16 (3)
chi square =	14.35	326.43	345.73
p =	<0.001	<0.001	<0.001

TABLE V. SEROLOGICAL ASSAY FOR VIRAL HEPATITIS BY HOSPITAL DISCHARGE DIAGNOSIS USAF ACTIVE DUTY, 1980–89.

	Serology			
Diagnosis	Anti-HAV	Anti-HBc	Anti-HCV	Neg. Serology
Hep A (n = 119)*	100	15	2	12
Hep B (n = 88)*	33	68	4	9
Hep NANB (n = 125)*	62	32	4	39
Total Hep (n = 332)*	195	116	10	60

* Some were serologically positive for more than one type of hepatitis.

recruits at entry would add much to our knowledge of the epidemiology within active duty forces. Intensive efforts to screen for and study the epidemiology of hepatitis C and E among USAF active duty members do not seem prudent at this time.

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